Technical Challenges in Reliable Microelectronics Packaging of Microelectromechanical Systems (MEMS) for Space Applications

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Abstract: MEMS have shown a significant promise in the last decade for a variety of applications such as air-bag, pressure sensors, accelerometer, microgyro, chemical sensors, artificial nose, etc. Standard semiconductor microelectronics packaging needs the integrated circuits (IC) to be protected from the harsh environment, and provide electrical communication with the other parts of the circuit, facilitate thermal dissipation efficiently, and impart mechanical strength to the silicon die. Microelectronics packaging involves wafer dicing, bonding, lead attachment, encapsulation to protect from the environment, electrical integrity, and package leak tests to assure the reliable IC packaging technology.

Active elements or microstructures in MEMS devices often interfaces with the hostile environment where packaging leak tests and testing of such devices using chemical and mechanical parameters will be very difficult and expensive. Packaging of MEMS is significantly complex as they serve to protect from the environment and microstructures interact with the same environment to measure or affect the desired physical or chemical parameters. The most of the silicon circuitry is sensitive to temperature, moisture, magnetic field, light, and electromagnetic interference. The package must then protect the on-board silicon circuitry while simultaneously exposing the microsensor to the effect it measures to assure the packaging technology of MEMS. MEMS technology has a major application in developing a microspacecraft for space systems provided reliability of MEMS packaging technology is sufficiently addressed. This MEMS technology would eventually miniaturize many of the components of the spacecraft to reach the NASA's goal by building faster, cheaper, better, smaller spacecraft to explore the space more effectively. This paper discusses the latest developments in the MEMS technology and challenging technical issues in the packaging of hermetically sealed and non-hermetically sealed MEMS sensor devices for microspacecraft applications.

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Brief Biography: Dr. R. Ramesham is working as a Senior Member of Engineering Staff at the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA. His present research works focus on the reliability of packaging and interconnects associated with the microelectromechanical systems applications. He also works on the application of polycrystalline synthetic diamond for MEMS, electrochemical, electroanalytical, and corrosion

resistant coating applications. His research work has addressed the fundamental issues involved in diamond processing techniques, heat dissipation techniques, and electrochemical applications of diamond. He has published over 92 refereed journal and proceedings articles and has made 60 national and international conference presentations. He has given invited presentations at the national and international conferences. He has offered a short course on "Fabrication of Thin Film Diamond Microstructures" at the First International Conference on the Applications of Diamond Thin Films and Related Materials, August 17-22, 1991, Auburn, AL.